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D1308 D1310B D1311 D1312

(56) Documents Cited
GB 0989126 A GB 0808823 A
US 4442726 A US 2997888 A

(58) Field of Search
UK CL (Edition V) F2D
INT CL[7] B62M, F16H
Other: Online: WPI, EPODOC, JAPIO.

(54) Abstract Title
A CVT arrangement

(57) A CVT arrangement 10 has levers 30,31,32,33 pivotally coupled at one end to a rotatable output shaft 16 via one-way clutches 34 and positioned at their other ends on a cam shaft like input member 14 in such a way that rotation of the input member 14 causes the levers 30,31,32,33 to pivot about the clutches 34 and turn the output shaft 16. The distance between the input 14 and output 16 is variable so as to alter the amount the levers 30,31,32,33 turn the output 16 and so alter the gear ratio.

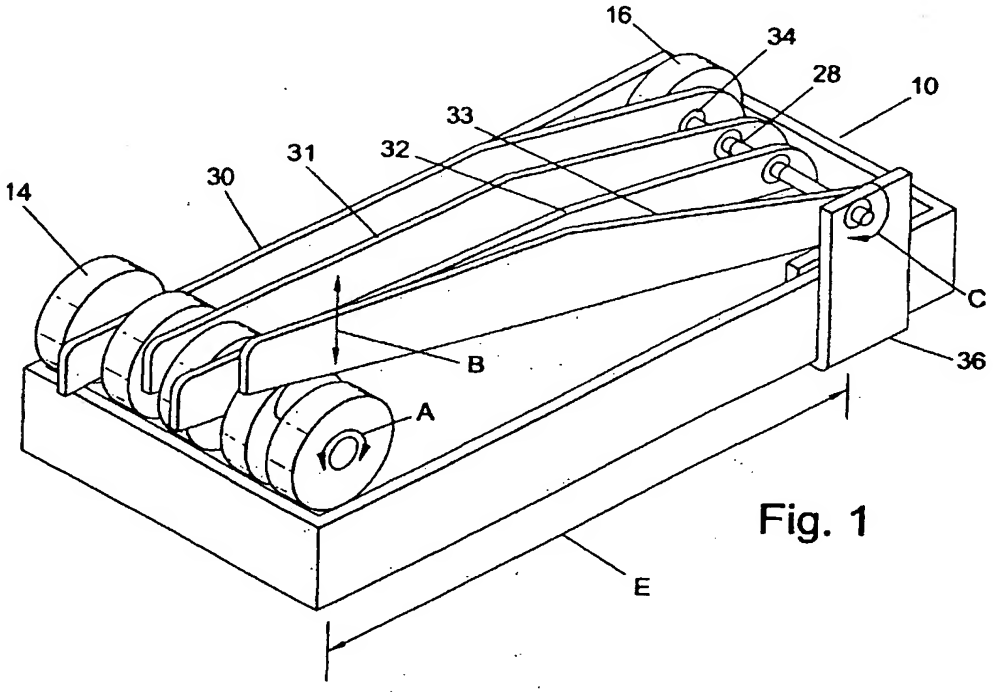

Fig. 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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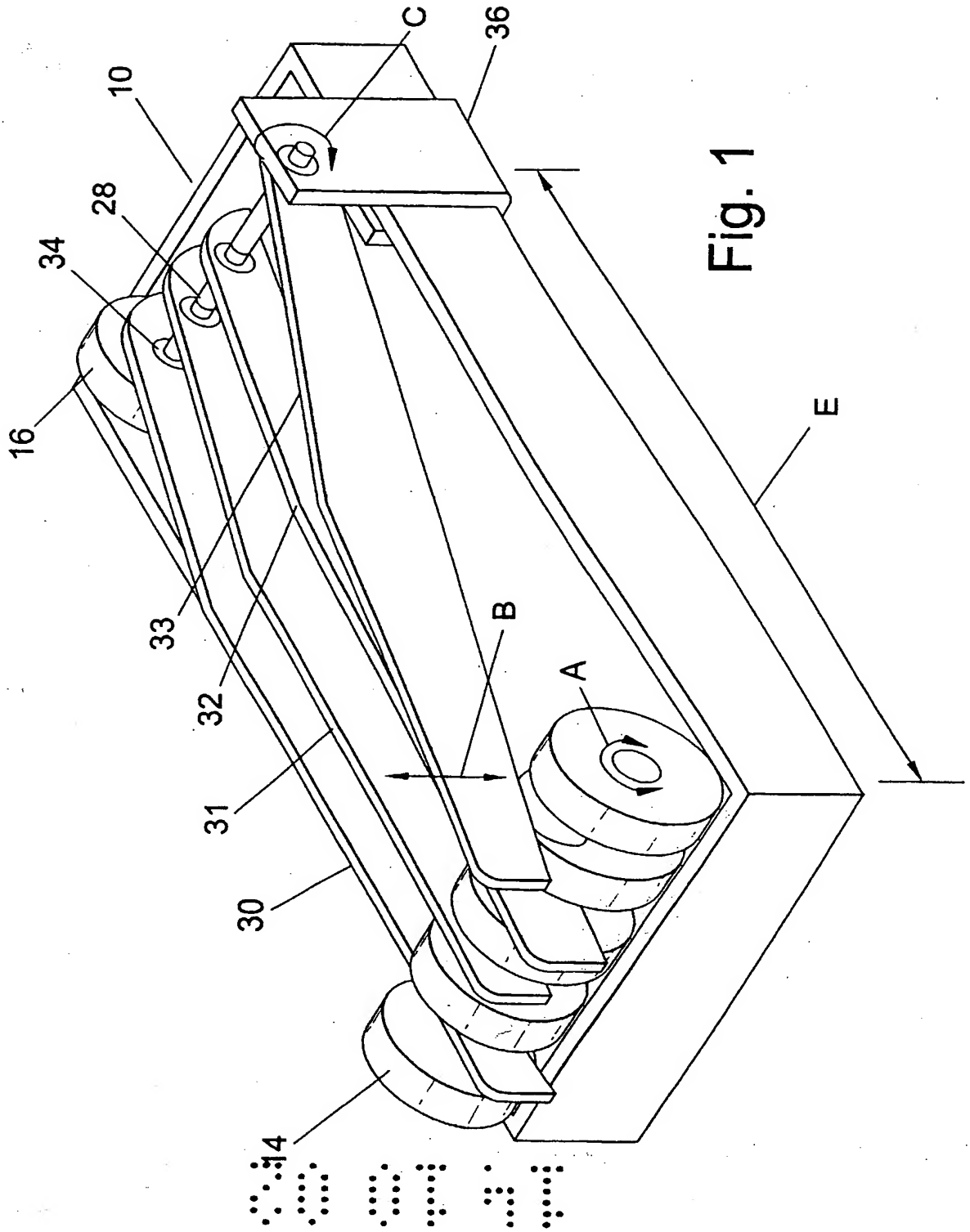

Fig. 1

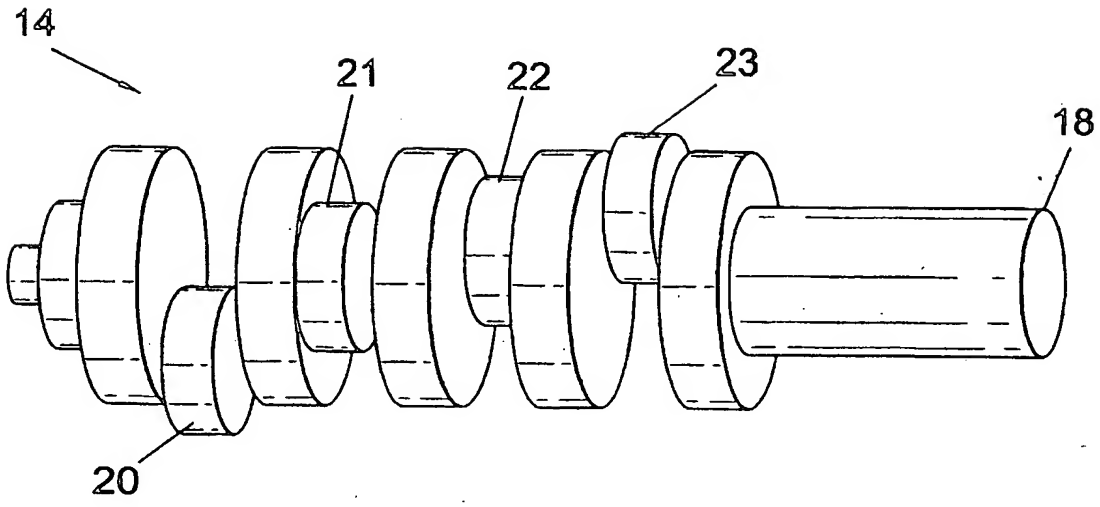

Fig. 2

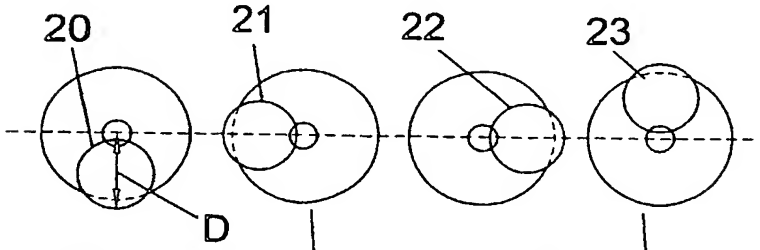

Fig. 3a Fig. 3c

Fig. 3b Fig. 3d

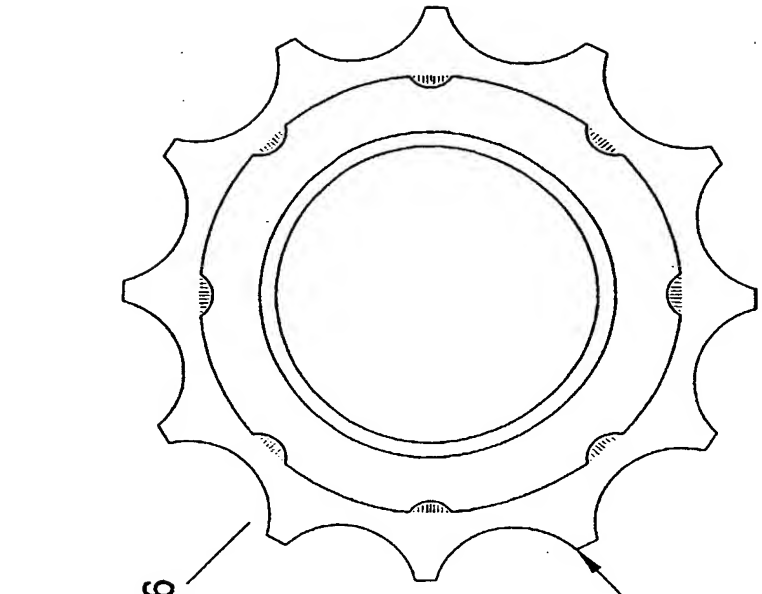

Fig. 4b

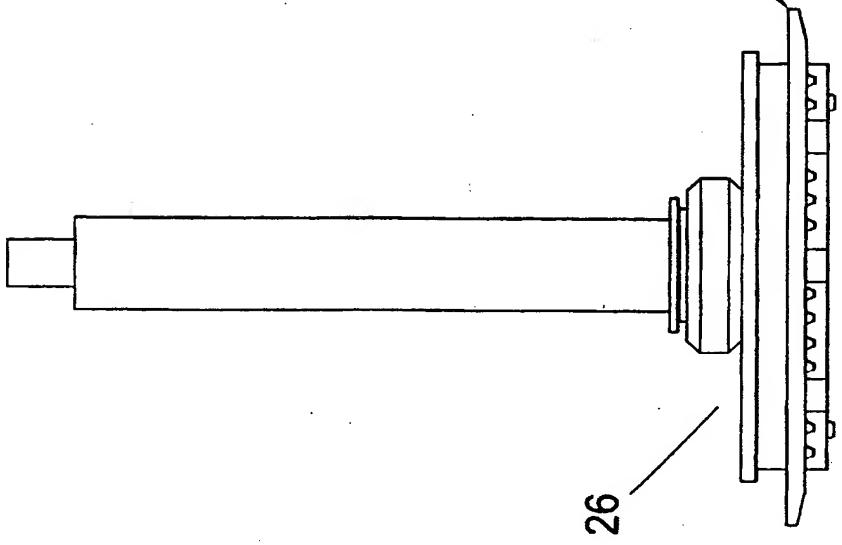

Fig. 4a

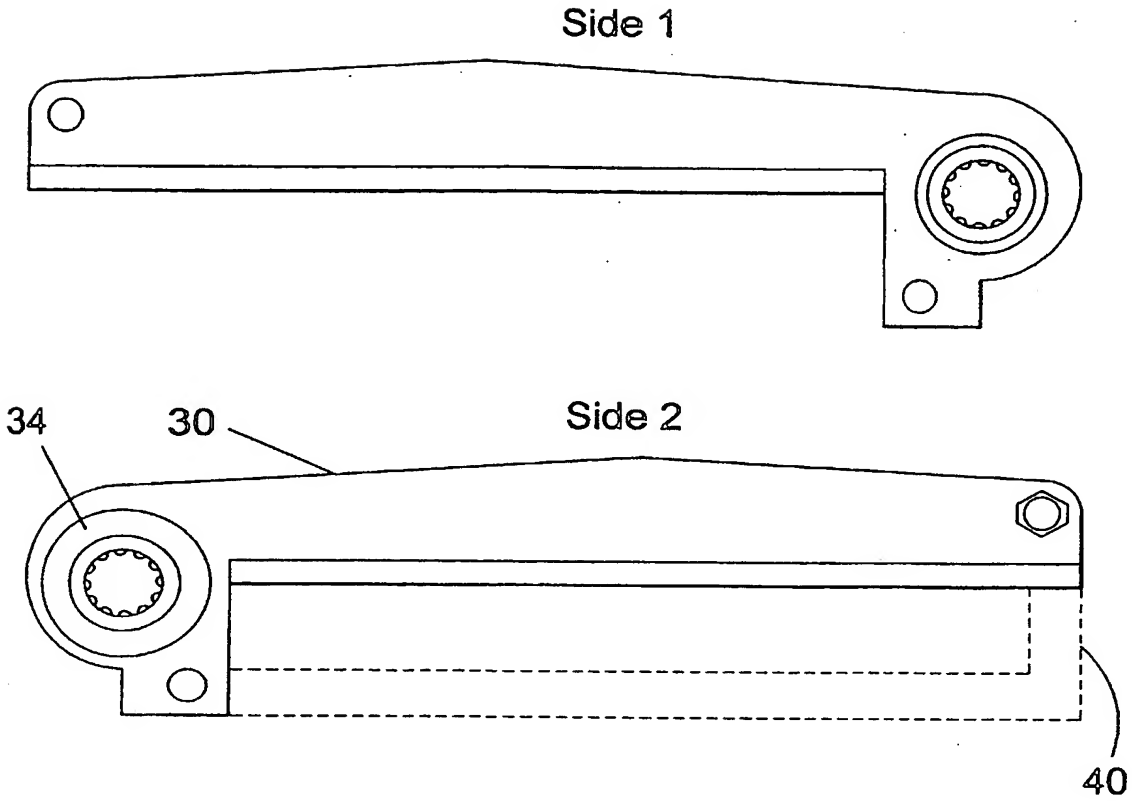

Fig. 5a

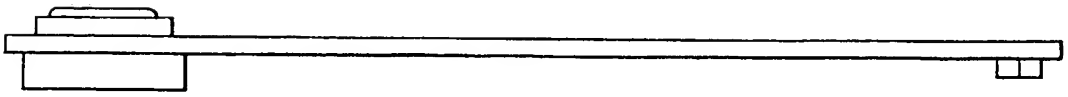

Fig. 5b

GEARING ARRANGEMENT

FIELD OF THE INVENTION

This invention relates to a gearing arrangement, and in particular but not exclusively to a variable ratio gearing arrangement.

BACKGROUND OF THE INVENTION

Gearing of one form or another is present in the majority of machines, including bicycles, motor vehicles and tractors. Most modern bicycles produced for recreational use include derailleur gearing. While such gearing is relatively efficient, in that it involves minimal losses, the gear mechanism is exposed and liable to accidental damage. Care is also required when changing gears, and difficulties may be experienced if a gearchange is attempted under load.

In modern motor vehicles, gearboxes are becoming increasingly sophisticated. However, modern gearboxes remain bulky and contribute significantly to the mass of the vehicle. Furthermore, such gearboxes absorb a significant amount of power. This latter disadvantage is particularly true of conventional "automatic" gearboxes.

Various proposals have been made to produce "step-less" or continuously variable gearboxes, that is gearboxes

in which there is no discernable step-change between ratios. However, such gearboxes have not been adopted on a large scale, and do not overcome many of the disadvantages of conventional gearboxes.

It is among the objectives of embodiments of the present invention to obviate or mitigate these disadvantages.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a gearing arrangement comprising;

an input member;

a rotating output member; and

a lever member having a pivot axis, one end of the lever member being coupled to the input member and the other end of the lever member being coupled to the output member via a one-way clutch arrangement such that movement of the input member induces reciprocal movement of said lever member and rotation of the output member, the coupling between the input member and the lever member being configurable to vary the degree of movement of the lever member, and thus the angle of rotation of the output member, induced by a predetermined degree of movement of the input member.

Thus, by controlling the configuration of the coupling between the input member and the lever member the gear

ratio provided by the arrangement may be varied.

Preferably, the changes in the configuration of the coupling may be effected in infinitely small increments, such that changes in gear ratio may be effected in a "stepless" manner.

Preferably, the pivot axis of the lever member corresponds to the axis of rotation of the output member, though in other embodiments the pivot axis may be spaced from the output member axis.

Preferably, the input member is rotatable. The input member may reciprocate, but preferably is adapted to be driven to rotate in one direction or the other.

Preferably, the one way clutch is a mechanical clutch arrangement, such as a sprag, index or roller clutch, or a ratchet. Alternatively, other non-mechanical clutch forms may be utilised, including variable configuration clutches which permit the direction of drive transfer to be varied.

Preferably, the coupling between the input member and the lever member is in the form of a cam profile on the input member engaging a follower surface of the lever member. With such a coupling, variation in gearing may be effected by varying the distance, along the length of the lever member, between the point of contact between the input member and the lever member follower surface, and the lever member pivot axis. Conveniently, this is achieved by translation of one of the input member or the output member

relative to a housing which provides mounting for the parts of the arrangement. Of course other coupling configurations may be utilised, including a crank arrangement on the input member, which crank member may permit translation of the input member relative to the lever member pivot axis, or may incorporate a variable throw arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

This and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective schematic representation of a gearing arrangement in accordance with a preferred embodiment of the present invention;

Figure 2 is a perspective view of an input camshaft of the gearing arrangement of Figure 1;

Figures 3a, 3b, 3c and 3d are sectional views of the camshaft of Figure 2 and illustrating the relative positioning of the cams on the shaft;

Figures 4a and 4b are plan and end view of an input cog of the gearing arrangement of Figure 1; and

Figures 5a and 5b are side and plan views of a lever arm and clutch of the gearing arrangement of Figure 1.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference is first made to Figure 1 of the drawings, which is a perspective view from above of a gearing arrangement 10 in accordance with a preferred embodiment of the present invention. The illustrated embodiment is intended for use in a relatively low power machine, such as a bicycle or moped and includes a housing 10 which provides mounting for a rotating input member 14 and a rotating output member 16. The housing 10 is illustrated as being open, however it will be recognised that the housing would normally enclose and protect the inner workings of the arrangement.

Reference is now also made to Figures 2, 3 and 4 of the drawings, which illustrate features of the input member 14. In particular, Figure 2 illustrates a cam shaft 18 which forms the main element of the member 14 and features four circular cams 20, 21, 22, 23 which are each offset a common distance from the axis of the shaft 18. Furthermore, the cams are positioned at 90° angular spacings from one another, as is apparent from Figures 3a to 3d. The cam shaft 18 is coupled to an input cog 26, as illustrated in Figures 4a and 4b of the drawings, the cog 26 being mounted externally of the housing 12.

The output member 16 is mounted towards the opposite end of the housing 12 from the input member 14 and comprises a shaft 28 coupled to an output cog (not shown)

mounted externally of the housing 12. Four levers 30, 31, 32, 33 are coupled to the output shaft 28 via respective one-way clutches 34, one of the levers 30 being illustrated in Figures 5a and 5b of the drawings. As may be seen from Figure 1, the free end of each lever 30, 31, 32, 33 rests on a respective cam 20, 21, 22, 23 of the input member 14. Thus, as the input member rotates 14 in direction A, the free ends of the levers 30, 31, 32, 33 rise and fall, in a reciprocal manner, as indicated by arrow B. Due to the provision of the clutches 34 between the levers 30, 31, 32, 33 and the output shaft 28, this reciprocal movement of the levers 30, 31, 32, 33 induces rotation of the output shaft 28 in direction C.

It has been found that by providing four cams 20, 21, 22, 23 operating in combination with four levers 30, 31, 32, 33, it is possible to achieve substantially continuous rotation of the output shaft 28 in response to rotation of the input member 14.

The degree of rotation of the shaft 28 induced by rotation of the input member 14 is related to the throw of the cams 20, 21, 22, 23, indicated as dimension D in Figures 3a, and also the length of the lever arm E, that is the distance between the contact point between each cam and lever, and the lever pivot axis, which in this example corresponds to the axis of rotation of the output shaft 28.

Figure 1 illustrates the gearing arrangement 10

configured to provide its lowermost ratio, that is to provide a relatively low speed but high torque output. In the illustrated arrangement 10, the gear ratio may be changed by varying the length of the lever arm E, which may be achieved by moving the output member 16 towards the input member 14, and thus shortening the lever arm E. In the illustrated embodiment, this is made possible by the mounting of the output member 16 between supports 36 (only one shown) which are movable along side members of the housing 12. Such movement may be achieved by any convenient arrangement.

As will be apparent to those of skill in the art, this arrangement allows the gear ratio between the input and output members 14, 16 to be varied in infinitely small increments, and without step changes. Accordingly, changes in gear ratio may be achieved smoothly and easily, without requiring use of a clutch-type arrangement to disengage the gearing arrangement 10 from the prime mover, and without reducing the power or loading being applied through the arrangement 10.

Those of skill in the art will recognise that the gearing arrangement 10 provides a simple and effective arrangement of providing a continuously variable gear ratio in a very simple and compact arrangement. Where the application requires, two or more gearing arrangements may be provided in series, to provide an appropriate range of

ratios.

Those of skill in the art will further recognise that the illustrated arrangement 10 is merely exemplary of the present invention, and that the same objectives may be achieved by using a variety of different configurations. For example, in other embodiments the output member may be fixed relative to the housing, while the input member is movable relative to the housing to vary the gear ratio obtained. In other embodiments a crank shaft and connecting rod arrangement may be utilised rather than a cam shaft and lever arrangement, variations in gear ratio being achieved by provision of a variable throw crank shaft or a coupling between the crank shaft and the connecting rods which permits relative movement of the crank shaft and the connecting rods to vary the distance between the crank shaft and the output member, or more particularly the pivot axis of the connecting rods. Furthermore, the above embodiment features four cams and levers, and those of skill in the art will recognise that other numbers of cams and levers may be utilised. In other embodiments, particularly where higher speeds are likely to be experienced, if levers are employed, there is a possibility that the levers will not follow the cams. In such cases a pull-down lever 40 may be provided, as shown in claim-dotted outline in Figure 5a.

CLAIMS

1. A gearing arrangement comprising;

an input member;

a rotating output member; and

a lever member having a pivot axis, one end of the lever member being coupled to the input member and the other end of the lever member being coupled to the output member via a one-way clutch arrangement such that movement of the input member induces reciprocal movement of said lever member and rotation of the output member, the coupling between the input member and the lever member being configurable to vary the degree of movement of the lever member, and thus the angle of rotation of the output member, induced by a predetermined degree of movement of the input member.

2. A gearing arrangement as claimed in claim 1, wherein the variation in the degree of movement of the lever member is effected in infinitely small increments.

3. A gearing arrangement as claimed in claim 1 or 2, wherein the pivot axis of the lever member corresponds to the axis of rotation of the output member.

4. A gearing arrangement as claimed in claim 1 or 2, wherein the pivot axis of the lever member is spaced from the output member axis.

5. A gearing arrangement as claimed in any preceding claim, wherein the input member is rotatable.

6. A gearing arrangement as claimed in any preceding claim, wherein the input member can reciprocate.

7. A gearing arrangement as claimed in any one of claims 1 to 5, wherein the input member is adapted to be driven to rotate in one direction.

8. A gearing arrangement as claimed in any preceding claim, wherein the one-way clutch is a mechanical clutch arrangement.

9. A gearing arrangement as claimed in any preceding claim, wherein the one-way clutch is a sprag clutch.

10. A gearing arrangement as claimed in any one of claims 1 to 8, wherein the one-way clutch is an index clutch.

11. A gearing arrangement as claimed in any one of claims 1 to 8, wherein the one-way clutch is a roller clutch.

12. A gearing arrangement as claimed in any one of claims 1 to 8, wherein the one-way clutch is a ratchet.

13. A gearing arrangement as claimed in any one of claims 1 to 7, wherein the one-way clutch is a non-mechanical clutch.

14. A gearing arrangement as claimed in claim 13, wherein the non-mechanical clutch is a variable configuration clutch.

15. A gearing arrangement as claimed in any preceding claim, wherein the coupling between the input member and the lever member is in the form of a cam profile on the input member engaging a follower surface of the lever member.

16. A gearing arrangement as claimed in claim 15, wherein variations in the degree of movement of the lever member may be effected by varying the distance, along the length of the lever member, between the point of contact between the input member and the lever member follower surface, and the lever member pivot axis.

17. A gearing arrangement as claimed in claim 16, wherein the distance between the point of contact between the input

member and the lever member follower surface is varied by translation of one of the input member or the output member relative to a housing which provides mounting for the parts of the arrangement.

18. A gearing arrangement as claimed in any one of claims 1 to 14, wherein the coupling between the input member and the lever member is in the form of a crank arrangement on the input member, which crank arrangement permits translation of the input member relative to the lever member pivot axis.

19. A gearing arrangement as claimed in claim 18, wherein the crank arrangement incorporates a variable throw arrangement.

20. A gearing arrangement substantially as described herein and shown in the accompanying representations.

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Application No: GB 0220357.8 13
Claims searched: 1-20

Examiner: Joe Mitchell
Date of search: 26 February 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1,2,4,5, 7-14,18,19	GB 989126 A	COLLINGHAM & OWEN LTD (adjustable positoning of pivot pin E via lever L arm P pivot with ratchet/pawl at shaft O)
X	1,2,4,5, 7-14,18,19	GB 808823 A	SZERSZAMGEPFEJLESZTOE INTEZET (varying pivot point Q to alter transmission ratio ; page 2 lines 17-23 disclose one-way ratchet clutch)
X	1-3,5, 7-14,18,19	US 4442726 A	BURROUGHS CORP (one way clutch 13, link arm 25 coaxial with output shaft 3, adjustable axial stroke)
X	1,2,4-,14, 18,19	US 2997888 A	JAMES HUNTER MACHINE COMPANY (adjuster 22, sprag clutch 12, input member may be taken as either the rotating wheel 29 or the reciprocating arm 28)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

F2D

Worldwide search of patent documents classified in the following areas of the IPC[7]:

B62M ; F16H.

The following online and other databases have been used in the preparation of this search report:

Online: WPI, EPODOC, JAPIO.